

Agricultural Technology Transfer Methods and Adaptability of Rural Farmers in Ikwerre Local Government Area of Rivers State

A.U. Nnodim¹, Raji W.I^{2*}

Department of Vocational and Technology Education, Faculty of Education,
Rivers State University

Corresponding Author: Raji W.I wale.raji@ust.edu.ng

ARTICLE INFO

Keywords: Agricultural Technology, Transfer, Methods, Adaptability, Rural Farmers

Received : 18, April

Revised : 22, May

Accepted: 16, June

©2023 Nnodim, Raji: This is an open-access article distributed under the terms of the [Creative Commons Attribution 4.0 International](https://creativecommons.org/licenses/by/4.0/).



ABSTRACT

The study investigated that agricultural technology transfer methods and adaptability of rural farmers in Ikwerre Local Government Area of Rivers State. The sample size used for the study was 120 rural farmers. Cluster random sampling was used to select ten (10) rural women farmers from 12 communities of Ikwerre Local Government Area. Two instruments for data collection were used in the study. One was "Agricultural technology transfer methods questionnaire". The second research instrument was "Farmers Adaptability to Agricultural Technology Questionnaire". The study found that farmer-to-farmer method and household method of transferring agricultural technologies have strongest and significant relationship with farmers' adaptability to new technological innovations than other methods. It was recommended that government should provide adequate fund for extension workers basically for encouraging household, farmer-to-farmer method in transferring agricultural innovation.

INTRODUCTION

The application of agricultural technology has enabled agricultural sector to be able to meet the rising demands for food occasioned population increase. Consequently, modern agriculture engages in the usage of various sophisticated technologies (Amadi & Okagwa, 2020). Agricultural technology is the integration of advanced engineering principles, farming techniques and scientific development to manipulate the growth, maturity and well-being of crops and livestock (Nnodim & Raji, 2020). The authors further stated that that agricultural technologies could be regarded as improved farming mechanics probably carried out by using farm implements so as to boost the growth and production of agricultural produce. In the view of Djibo and Maman (2019) agricultural technologies to include; improved seeds, agro-chemicals, land conservation practices, tractors, stall-feeding management and irrigation technologies. Over the years important technological developments that have led to improve agricultural productivity include hybrid seed, fertilizers, pesticides, mechanical improvements, and livestock and poultry vaccines (Anderson, 1989). Hence, agricultural technologies encompass various aspects of farming as contrary to the crude or traditional means of farming which then leads to a faster and more farm productivity.

According to Mgendi and Cheng (2019), African traditional agricultural practices should necessarily be replaced by appropriate technology practices, which may offer a great avenue for farmers to shift from poor to high yield and farming practices. Amadi and Okagwa (2020) posited that agricultural technology aims to produce faster and larger farm products for consumption of the masses as traditional farming is limited in its capacity to produce a miniature quantity of food. It is based on this impediment Rehman, Jingdong, Khatoon and Hussain (2016) suggested that agricultural technologies such as inorganic fertilizer, pesticides, animal feedstuffs, tractors and other agricultural machineries should complement or where possible substituted natural resources and processes.

Agricultural technology transfer occurs when an individual acquires, imitates, or adapts technology developed elsewhere, to improve the level of his/her agricultural productivity. Inadequate assimilation of technology is limiting the rate of agricultural growth over time, and thus affect both quantity and quality of what is produced. In line with this, the food demand in Africa keeps increasing behind production capacity, suggesting the needs for technical upscaling to improve farm yield (Mgendi & Cheng, 2019). Methods of transferring agricultural technology include things like demonstrations and extension agents paying personal visits to farmers. In extension work, several approaches are employed. Methods such as word-of-mouth, focus groups, and the media are just a few examples. Among these approaches, there is no one that seem to be superior to each other, since each has its own set of benefits and drawbacks (Ruzzante, Labarta & Bilton, 2021). Governments and aid groups have long touted the use of agricultural technology as a means to boost farm output and decrease poverty. Many promising technologies have had sluggish adoption rates despite their obvious benefits. Based on similarities and

differences between adopters and non-adopters, many empirical studies of adoption have sought to determine the driving force behind the adoption process. The study of Ruzzante, et al (2021) showed that average, farmer education, household size, land size, access to credit, land tenure, access to extension services, and organization membership positively correlate with the adoption of many agricultural technologies. Technologies in the categories of improved varieties and chemical inputs are adopted more readily on larger farms, which casts doubt on the scale-neutrality of these technologies (Ruzzante, et al. 2021). The method used in transferring agricultural technologies to rural farmers is as significant as the technology itself it would be adopted by farmers.

The farmer-to-farmer extension has its origins in Guatemala in the 1970s, spreading to Nicaragua in the 1980s, then Mexico and Honduras. It is currently practiced widely in many other countries in Latin America, Asia and Africa in different forms (Weinand, 2002). Scarborough et al., in Meena, Kale, Singh and Shobhana (2016) described farmer-to-farmer extension as “the provision of training by farmers to farmers, often through the creation of a structure of farmer promoters and farmer trainers”. Farmer to farmer method is an agricultural technology transfer method that requires the use of a lead farmer to create awareness and teaching of trainee farmers on the potentialities, usability and challenges of agricultural technologies for maximum agricultural productivity. Farmer to farmer extension approach is defined as the provision of training by farmers to farmers often through the creation of a structure of farmer promoters and farmer trainer. In this approach the term Lead farmer is used for those farmers who are selected by extension officer to be trained to train their fellow farmers (Cooper, 2016). She further posited that the objective of farmer-to-farmer method is to encourage individual smallholder farmers to adopt the innovation approach that will enable farmers produce quality food to assist the country self-sufficiency. Hence, when a farmer (lead farmer) is being trained on the utilization of an agricultural technology for the purpose of disseminating the innovation to other farmers could be regarded as farmer-to-farmer method.

Farmer to-farmer approach is one such approach which emphasizes the role of farmers in the extension model. Farmers are not only stands at receiving end of the approach but works for the formation of it. F2F approach helps in building the effective, farmer-centred extension systems and empowering farmers as change agents for improving livelihoods in their communities. F2F model can reduce the extension cost and workload of extension functionaries (Meena, et al. 2021). The study of Franzel, Wambugu, Nanok, and Coe, (2007) showed that through farmer-to-farmer method 67 percent of fodder shrub adopters pass on information and planting materials to a few relatives and friends. In another study carried out by Kiptot, Franzel and Kirui (2012), volunteer farmers who are trained by extension officers could easily disseminate new technologies to other farmers. Such persons can be mobilized to increase the flow of agricultural technology. However, extension works are not only disseminated through farmer-to-farmer method alone, studies have

also proven that household method appears to be effective, although with some impediments.

According to Azumah, Donkoh and Awuni, (2018) the household or individual extension method is effective for activities undertaken by or within the full control of the individual farmer or household. Discussion with the whole family highlights more problems, and more experience is brought to the discussion (Anandajayasekeram, Puskur, Sindu & Hoekstra, 2008). However, the household or individual extension method is characterized by high cost in terms of time and transportation. Only a few farmers may actually be visited. Also, the area covered is small since all the effort is concentrated on a few farmers or households per given time. Individual or face-to-face methods are probably the most universally used extension methods in both developed and developing countries (Food and Agriculture Organization, n.d). The extension agent meets the farmer at home or on the farm and discusses issues of mutual interest, giving the farmer both information and advice. The atmosphere of the meeting is usually informal and relaxed, and the farmer is able to benefit from the agent's individual attention. Individual meetings are probably the most important aspect of all extension work and invaluable for building confidence between the agent and the farmer. In the study of Azumah et al (2018) found that the household or individual extension method came third among the extension methods that were considered. According to them, farmers by this method get to know about information from household members who have come in contact with such technologies either by learning from colleague farmers or other extension systems. In another study by Azumah (2019) farmers trained with household method had a higher probability to adopt improved technologies such as bunding, irrigation, line planting, briquetting, spacing, harrowing and nursery establishment. Despite the efficiency of household method, it seems to be hindered by distance and difficulty to reach farmers in their numbers.

Mass media approach of agricultural technology transfer is found to be the most important means of communicating agricultural information to rural inhabitants (Abebe, 2021). The study of Abebe (2021) indicated that majority of farmers own radio set and they tend to follow agricultural program. Also, in another study Abebe (2020) noted that Farmers can also get appropriate advices of experts through these media to cope up with the emerging problems (Albarran, 2002). Important electronic media pertinent to agriculture include radio, television, audio/video cassettes, telephone, internet, agri-help line, and mobile phone). Kuponiyi (2000), radio is one of the broadcast medium which the rural populations are very familiar with and which almost all experts identified to be the most appropriate for rural emancipation program. This is because radio beats distance and has immediate effect on farmers. Both individual and group contact methods have limited scope in the scenario of vast and scattered areas to be covered and rapid advances in science and technology. It seems difficult for extension to reach the farmers effectively and efficiently through direct personal contacts. Contrarily, in as much as the mass

media tends to be fast in creating awareness of agricultural technologies, it seems to be poor in enhancing adaptability to new agricultural innovations.

THEORETICAL REVIEW

Statement of the Problem

The ineffectiveness and slow progress of adopting agricultural innovation over the last few decade have led to dissatisfaction among agricultural technology researchers. Developing technologies suitable for Africa is only one step in helping increase food production. Those technologies also must be adapted and disseminated among the African people. This calls for successful technology transfer. Differing opinions exist on the best methods for effectively reaching the poorer smallholders.

In recent times due to the prevalence of social media and other mass media, many developments in agriculture are now internet or social media based. This method allows for only internet literate farmers to have access to innovation leaving the non-literate rural farmers behind. This has resulted to low adaptability of agricultural innovations especially among rural farmers. Consequently, grassroot agriculture tends to suffer maximum productivity, reduced food security and poor technology utilization. Therefore, the present study sought to determine the relationship between agricultural technology transfer methods and adaptability of rural farmers in Ikwerre local government area of Rivers State.

Purpose of the Study

The major purpose of the study is to investigate agricultural technology transfer methods and adaptability of rural farmers in Ikwerre Local government Area of Rivers State. In specific terms the study sought to;

1. Determine the relationship between farmer-to-farmer method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State
2. Determine the relationship between household method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State
3. Determine the relationship between mass media approach and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State.

Research Questions

The following questions guided the conduct of the study

1. What is the relationship between farmer-to-farmer method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State?
2. What is the relationship between household method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State?
3. What is the relationship between mass media approach and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State?

Hypotheses

1. There is no significant relationship between farmer-to farmer method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State.
2. There is no significant relationship between household method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State.
3. There is no significant relationship between mass media approach and adaptability of rural farmers in Ikwerre local government Areas of Rivers State.

METHODOLOGY

The study adopted a correlation research design. The type of design was adopted because the study would seek to establish the relationship between the method of transferring agricultural technologies and the extent of adaptability of rural farmers. The study was carried out in Ikwerre Local Government Area, Rivers State. Ikwerre Local Government Area is one of the 23 local government area in Rivers State. Ikwerre Local Government Area is located within latitudes 40 55' and 50 15' N and between longitudes 60 40' and 60 55' E. The population of the study involved all the rural farmers in Ikwerre Local Government Area. As at the time of the study there was no exact number that represents the total population of rural farmers in the study area. The sample size used for the study was 120 rural farmers. Cluster random sampling was used to select ten (10) rural women farmers from these communities which include: Isiokpo, Omagwa, Omudeme, Elele, Omuanwa, Apani, Ipo, Omerelu, Igwuruta, Ubima, Ozuaha and Aluu.

Two instruments for data collection were used in the study. One was "Agricultural technology transfer methods questionnaire (ATTMQ)". The instrument was designed by the researcher to elicit information from the respondents on their preferable methods for agricultural technology transfer. The instrument was designed in four-point rating scale of Strongly Agree (SA-4), Agree (A-3), Disagree (D-2), Strongly Disagree (SD-1). The second research instrument was "Farmers Adaptability to Agricultural Technology Questionnaire (FAATQ)". FAATQ was designed to obtain data from farmers on the extent of their adaptability to new agricultural technology. The instrument was structured in Very High Extent (HE-4), High Extent (HE-3), Low Extent (LE-2) and Very Low Extent (VLE-1). The two questionnaires were validated by experts in agricultural education and extension, Rivers State University. The reliability of the instrument was established using Cronbach Alpha formula. The reliability coefficient obtained for the three factors (Farmer to farmer method, Household method and Mass media approach) in ATTMQ were 0.76, 0.87 and 0.99 while the coefficient value obtained in FAATQ was 0.88. These coefficient values indicated that the instrument for data collection was reliable. Pearson Product Moment Correlation was used to answer the research questions while z-transformation was used to test the null hypothesis at 0.05 level of significance. According to Amadi (2020), the decision rules for Pearson Product Moment Correlation. The following are the decision rules:

Table 1. Decision Rules

1.00	Perfect Correlation
0.90-0.99	Very Strong Correlation
0.70-0.89	Strong Correlation
0.50-0.69	Moderate correlation
0.31- 49	Low Correlation
0.00-0.30	Very Low Correlation

RESULTS

Research Questions 1: What is the relationship between farmer-to-farmer method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State?

Table 2. Correlation Analysis between Farmer-to-Farmer Method and Adaptability of rural farmers in Ikwerre Local Government Area, Rivers State

Variable	N	$\sum X$	$\sum X^2$	R	RMKS
		$\sum Y$	$\sum Y^2$		
X	120	3543	11760		
				0.88	Strong Positive Correlation
Y	120	3052	12902		

Source: Field Survey, 2022; X- Farmer to Farmer Method; Y- Adaptability of Rural Farmers

Table 2 shows the summary of correlation analysis using Pearson Product Moment Correlation Analysis between farmer-to-farmer method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State. The analysis showed that the correlation coefficient (r-value) was 0.88. The correlation coefficient of 0.88 indicated that the relationship between the two variable (Farmer to farmers method of agricultural technology transfer and adaptability of rural farmers) is a strong positive relationship. This means that the use of farmer to farmer method is strongly related to farmers' adaptability to new agricultural technologies. That is when agricultural technologies are transferred to rural farmers using farmer-to-farmer method, there is a tendency that farmers adaptability becomes hasten and sustainable.

Research Question 2: What is the relationship between household method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State?

Table 3. Correlation Analysis between Household Method and Adaptability of Rural Farmers in Ikwerre Local Government Area, Rivers State

Variable	N	$\sum X$	$\sum X^2$	R	RMKS
X	120	3319	10720		
		$\sum Y$	$\sum Y^2$	0.72	Strong Positive Correlation
Y	120	3052	12902		

Source: Field Survey, 2022; X- Household Method; Y- Adaptability of Rural Farmers

Table 3 shows the summary of correlation analysis using Pearson Product Moment Correlation Analysis between household method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State. The analysis showed that the correlation coefficient (r-value) was 0.72. The correlation coefficient of 0.72 showed that the relationship between the two variables (Household method of agricultural technology transfer and adaptability of rural farmers) is a strong positive relationship. This means that the more household method is used for agricultural technology transfer, the more rural farmers adapt to the new agricultural innovation. The correlation coefficient affirmed that household method is strongly related to farmers' adaptability to new agricultural technologies.

Research Question 3: What is the relationship between mass media approach and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State?

Table 4. Correlation Analysis between Mass Media Approach and Adaptability of Rural Farmers in Ikwerre Local Government Area, Rivers State

Variable	N	$\sum X$	$\sum X^2$	R	RMKS
X	120	2032	9465		
		$\sum Y$	$\sum Y^2$	0.32	Low Positive Correlation
Y	120	3052	12902		

Source: Field Survey, 2022; X- Mass Media Approach; Y- Adaptability of Rural Farmers

Table 4 presents the summary of correlation analysis using Pearson Product Moment Correlation Analysis between **mass media approach and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State.**

The correlation coefficient obtained was 0.32. The analysis revealed that the r-value (0.32) according to the decision rule, the correlation coefficient indicates that the relationship between the two variables under investigation (Mass media approach and adaptability of rural farmers) is a low positive relationship. This indicates that the use of mass media approach for transferring agricultural technology results to low adaptability of farmers. When mass media method is being used to transfer agricultural innovations, the tendency of farmers adopting the new technology tends to be very slow.

Hypotheses

H₀₁: There is no significant relationship between farmer-to farmer method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State.

Table 5. Z-Transformation Analysis on the Correlation Analysis between Farmer-to Farmer Method and Adaptability of Rural Farmers in Ikwerre Local Government Area, Rivers State

Variable	N	$\sum X$	$\sum X^2$	Df	α	r _{calc}	z _{calc}	Z _{crit}	RMKS
X	120	3543	11760	118	0.05	0.88	4.15	1.96	Reject H ₀
Y	120	3052	12902						

Field Survey, 2022, X- Farmers to Farmers, Y- Adaptability of Rural Farmers

Table 5 presents the summary of z-transformation analysis on the correlation between farmer-to farmer method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State. The Pearson Product moment correlation coefficient value obtained was 0.88 which indicated that the relationship between the two variables under investigation was strong and positive. However, to establish the significance of the correlation coefficient value, z-transformation value (4.15) was obtained. Comparing the z-cal value (4.15) with the critical z-value of 1.96 at 0.05 level of significance with a degree of freedom of 118, shows that the relationship was significant. This means that the null hypothesis was rejected. The relationship between farmer-to farmer method and adaptability of rural farmers is not due to chance or error.

Hypothesis 2: There is no significance relationship between household method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State

Table 6. Z-Transformation Analysis on the Correlation between Household Method and Adaptability of Rural Farmers

Variable	N	$\sum X$	$\sum X^2$	Df	α	r _{calc}	z _{-calc}	Z _{crit}	RMKS
X	120	3319	10720	276	0.05	0.72	5.99	1.96	Reject H ₀
Y	120	3052	12902						

Table 6 presents the summary of z-transformation analysis on the correlation between household method and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State. The Pearson Product moment correlation coefficient value obtained was 0.72 which indicated that the relationship between the two variables under investigation was positively strong. However, to establish the significance of the correlation coefficient value, z-transformation value (5.19) was obtained. Comparing the z-cal value (4.15) with the critical z-value of 1.96 at 0.05 level of significance and a degree of freedom of 118, shows that the relationship was significant. This means that the null hypothesis was rejected. The relationship between household method and adaptability of rural farmers is not due to chance or error.

Hypothesis 3: There is no significant relationship between mass media approach and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State

Table 7. Z-Transformation Analysis on the Correlation between Mass Media Approach and Adaptability of Rural Farmers in Ikwerre Local Government Area, Rivers State

Variable	N	$\sum X$	$\sum X^2$	Df	α	r _{calc}	z _{-calc}	Z _{crit}	RMKS
X	120	2032	9465	276	0.05	0.32	1.18	1.96	Reject H ₀
Y	120	3052	12902						

Table 7 presents the summary of z-transformation analysis on the correlation between mass media approach and adaptability of rural farmers in Ikwerre Local Government Area, Rivers State. The Pearson Product moment correlation coefficient value obtained was 0.32 which indicated that the relationship between the two variables under investigation was a low positive relationship. However, to establish the significance of the correlation coefficient value, z-transformation value (1.18) was obtained. Comparing the z-cal value (1.18) with the critical z-value of 1.96 at 0.05 level of significance and a degree of freedom of 118, shows that the relationship was

insignificant. This means that the null hypothesis was upheld. That is, the relationship between mass media approach and adaptability of rural farmers is due to chance or error.

DISCUSSION

Firstly, the study found that the relationship between the Farmer to farmers method of agricultural technology transfer and adaptability of rural farmers is a strong positive relationship. The tested hypothesis further affirmed that the relationship was not due to chance or error. This implies that the use of farmer-to-farmer method when transferring new agricultural innovations to rural farmers is likely to be effective in enhancing their adaptability to the newly introduced method. This finding is in line with Meena, et al (2021) farmer to farmer approach helps in building the effective, farmer-centred extension systems and empowering farmers as change agents for improving livelihoods in their communities. Supporting this finding, Franzel, et al. (2007) revealed that through farmer-to-farmer method 67 percent of fodder shrub adopters pass on information and planting materials to a few relatives and friends. Similarly, Kiptot, et al. (2012), volunteer farmers who are trained by extension officers could easily disseminate new technologies to other farmers.

Secondly, the findings of the study showed that relationship between the household method of agricultural technology transfer and adaptability of rural farmers is a strong positive relationship. Also the hypotheses showed that the relationship was significant. This shows that household method or group method of transferring agricultural technology has the tendency to enhance the farmers adaptability to agricultural technologies introduced to them. This may be because, when farmers learn together in group, they tend to be motivated by each other to adapt agricultural technologies. This finding is aligns with Azumah et al (2018) who found that the household or individual extension method came third among the extension methods that were considered, with a mean rank of 3.95. The further posited that farmers by this method get to know about information from household members who have come in contact with such technologies either by learning from colleague farmers or other extension systems.

Lastly, the study found that the relationship between Mass media approach and adaptability of rural farmers is a low positive relationship. This indicates that the use of mass media approach for transferring agricultural technology results to low adaptability of farmers. When mass media method is being used to transfer agricultural innovations, the tendency of farmers adopting the new technology tends to be very slow. This finding disagrees with the study of Abebe (2021) indicated that majority of farmers own radio set, follow agricultural program and enhance farmers adoption to new agricultural innovations

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the study it was concluded that farmer-to-farmer method and household method of transferring agricultural technologies has a strong and significant relationship with farmers' adaptability to new

technological innovations. Farmers tends adapt to new agricultural innovation quickly when farmer-to-farmer methods and household method is used as a means technology transfer. However, the also showed that mass media method has low positive relationship with farmers adaptability to agricultural technology. The study recommended that:

1. Government should mobilize agricultural extension agencies with fund to motivate them to painstakingly make use of individual method or farmer-to farmer method when transferiing new agricultural technologies to rural farmers. This is because farmers to farmer method of agricultural technology transfer seems to be very demanding and tasking for extension officers.
2. Government also should encourage rural communities through the provision of town halls which could be a tool for extension officers to carryout household method agricultural technology transfer to rural farmers.
3. Agricultural extension agencies should only utilize mass media for creating awareness for rural farmers pertaining new agricultural innovation and not for the intent of adoption. This very less rural farmers seem to pay attention to mass media concerning learning new innovations in agriculture.

REFERENCES

- Abebe, C. (2021) Mass Media and its role in agricultural technology transfer: The case of Dendi and Ejere Weredas, Oromia, Ethiopia. *Journal of Agriculture & Rural Development* 6, 66-77
- Amadi, N.S. & Okagwa, P.O. (2020), Effects of modern agricultural technology on the teaching and learning of agricultural science in senior secondary schools in EMOLGA, Rivers state. *African Journal of Agriculture and Food Science*, 3 (3), 1-11
- Anandajayasekeram, P., Puskur, R., Sindu, W., & Hoekstra, D. (2008). Concepts and practices in agricultural extension in developing countries: A source book. Nairobi, Kenya: International Food Policy Research Institute (IFPRI), Washington, DC, U.S.A, and International Livestock Research Institute
- Anderson, M. (1989). *International Technology Transfer in Agriculture*. United States Department of Agriculture.
- Azumah, S.B. Donkoh, S.A & Awuni, J.A. (2018). *Cogent Food & Agriculture*(2018), 4: 1503798 <https://doi.org/10.1080/23311932.2018.1503798>
- Cooper, V.J. (2016) *Farmer to Farmer Learning Approach*. MEAS-Liberia Ministry of Agriculture Cuttington University Write Shop.
- Franzel, S., Wambugu, C., Nanok, T. & Coe, R. (2013). The 'model farmer' extension approach revisited: Are expert farmers effective innovators and disseminators? In: CTA, *Proceedings of the International Conference on Innovations in Extension and Advisory Services: Linking Knowledge to Policy and Action*, November 15-18, 2011, Nairobi, Kenya. CTA, Wageningen, Netherlands.
- Food and Agriculture Organization (n.d). *The guide Training*. Retrieved from <https://www.fao.org/3/t0060e/T0060E01.htm#Foreword>
- Kiptot, E., Franzel, S. & Kirui J. (2012). *Volunteer farmer trainers: Improving smallholder farmers' access to information for a stronger dairy sector*. ICRAF Policy Brief no. 13. World Agroforestry Centre. Retrieved from <http://www.worldagroforestry.org/downloads/publications/PDFS/PB12236.PDF>
- Kuponiya FA (2000). *Mass Media in Agricultural Development: The use of Radio by Farmers of Akinyele Local Government Area of Oyo State, Nigeria*. *Nigeria Agricultural Development Studies*, 1 (1). 26-32.
- Meena, M.S., Kale, R.B., Singh, S.K. & Shobhana G. (2016). *Farmer-to-Farmer Extension Model: Issues of Sustainability & Scalability in Indian Perspective*. ISEE National Seminar, retrieved from <https://krishi.icar.gov.in/jspui/bitstream/123456789/1860/1/Meena%20et%20al.pdf>
- Mgendi, G. & Cheng, X (2019). *A Review of Agricultural Technology Transfer in Africa: Lessons from Japan and China Case Projects in Tanzania and Kenya*. *Sustainability* 2019, 11 <https://doi.org/10.3390/su11236598>

- Nnodim, A. U. & Raji W.I. (2020). Assessment of Agricultural Technology Adoption Behaviour among Crop Farmers in Ikwerre Local Government Rivers State. *Asian Research Journal of Agriculture* 12(2): 16-26
- Rehman, A. Jingdong, L. Khatoon, R., Hussain, I. (2016). Modern Agricultural Technology Adoption its Importance, Role and Usage for the Improvement of Agriculture. *American-Eurasian Journal of Agricultural & Environmental Sciences* 16 (2) 284-288. DO - 10.5829/idosi.aejaes.2016.16.2.12840
- Ruzzante, S., Labarta, R. & Bilton, A (2021). Adoption of agricultural technology in the developing world: A meta-analysis of the empirical literature. *World Development*, 146, <https://doi.org/10.1016/j.worlddev.2021.105599>.
- Weinand, J. (2002). Farmer-to-farmer extension: Opportunities and constraints of reaching poor farmers in southern Malawi. Unpublished Master's Thesis. University of Hohenheim, Germany.